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ABSTRACT

Open-ended learning environments (OELEs) provide contexts to support exploration, experimentation, and problem-solving. This paper creates a context for understanding the issues and challenges associated with the design and development of OELEs. Discussion first centers on characteristics of OELEs which differ from traditional learning environments in the roles of context, the importance of multiple resources and tools, and the responsibilities of the learner. Next, the following assumptions are presented, along with the associated design issues: (1) understanding is best achieved when situated in relevant contexts that support the learner in connecting personal beliefs and experiences with formal concepts; (2) provision of resources and tools help learners connect and manipulate understanding; and (3) learners must take more responsibility for monitoring and reflecting upon the learning process. A conceptual framework for designing OELEs is then presented. Its contents include: context, resources, learners, and evaluation. (Contains 27 references.) (AEF)

Open-Ended Learning Environments (OELEs): A Framework for Design and Development

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Abstract

Interest in creating productive and meaningful learning environments has been an enduring theme in the educational arena. Open-ended learning environments (OELEs) provide contexts to support exploration, experimentation, and problem-solving. The purpose of this paper is to create a context for understanding the issues and challenges associated with the design and development of OELEs.

Interest in creating productive and stimulating learning environments is an enduring theme in the educational arena. Open-ended learning environments (OELEs), learning environments designed with the intent of supporting the development of understanding, are drawing attention in the educational arena. In OELEs, experience and context are critical for cultivating cognitive processes that support understanding. Several processes are essential in these environments: exploration and experimentation; problem-solving and critical thinking; and angling, or viewing from multiple perspectives (Duchastel, 1990). While the creation of learning products or outcomes remain important to knowing, processes and strategies are the focal points of growth in understanding in OELEs (Hannafin, Hall, Land, & Hill, 1994; Papert, 1993).

A variety of frameworks can be used to establish OELEs, ranging from the classroom to computer-based environments. In classroom settings, OELEs focus on the learner. The instructor adopts the role of facilitator as opposed to one of leader. Additionally, the instructor is but one resource from which the learner seeks information; peers, parents, those working in the community, as well as print and electronic resources are all important in assisting the learner in developing understanding. Technology-based learning environments developed following learner-centered principles like their classroom counterparts. However, unlike classroom environments where the learner works with the instructor in finding resources to gather information, technology-based OELEs provide a built-in range of tools and resources for learning. These resources are used by learners as they build and revise understanding.

The emphasis on cultivating processes and strategies increases the requirements on the learner to productively use and learn from open-ended environments. While the instructor or system can assist by guiding and facilitating, the learner determines how to use the available tools and resources to access and manipulate information deemed relevant (Hannafin, 1992; Spiro, Feltovich, Jacobson, & Coulson, 1991). The individual is critical for determining what s/he wants and/or needs to know, for accessing the information in the system, and for deciding whether or not the system contains what is needed (Perkins, 1993; Roth & Roychoudhury, 1993).

The challenges associated with creating open-ended learning environments are considerable. OELEs are a milieu of duality. They can be simplistic and focused or complicated, appearing virtually limitless in scope. OELEs are empowering, yet exacting; liberating, yet hindering; expansive, yet disorienting.

Learning and building understanding in an OELE may seem a daunting task, for both the learner and instructor. Yet, a greater challenge exists: the design and development of these environments. There are several critical, but as yet undeveloped, design and development requirements in creating OELEs. Truly learner-centered systems require more than a shifting of control to the learner; OELEs require that the environment be conceptualized in ways that make sense to the individual. Designing learning environments which empower learners to use available tools and resources in building and evolving self-directed understanding is a formidable challenge, particularly when one considers the "compliant" thinking shaped by conventional classroom activities (McCaslin & Good, 1992).

The purpose of this paper is to create a context for understanding the issues and challenges associated with the design and development of OELEs. We first discuss the characteristics of OELEs, contrasting them with traditional learning environments. Next, assumptions related to OELEs are presented, along with the associated design issues. Finally, a conceptual framework for the creation OELEs is presented.

Open-Ended and Traditional Learning Environments: Key Differences

OELEs differ from traditional learning environments in several ways. These differences involve the role of context, the importance of multiple resources and tools, and the responsibilities of the learner.

One of the key differences between the environments is that traditional learning environments do much of the work for the learner. While the learner certainly engages in some activities within the system, the activities, as well as the context in which those activities occur, has already been selected. OELEs, in contract, directly involve the learner in the effort. The learner is actively involved in establishing both the context, as well as the activities that will occur. While a framework is established for the learner in an OELE, this is merely a foundation on which they build. The scaffolding necessary in building understanding is provided by both the learner and instructor.

OELEs also differ from traditional learning environments in the importance of resources and tools. In traditional environments, these resources and tools are often pre-selected, awaiting use within the pre-defined context. Resources and tools hold a different position in OELEs. In these environments, not only is the learner responsible for making decisions related to which resources and tools will best meet their needs, they are also encouraged to examine multiple resources as they work to angle and integrate the information in building understanding (Duchastel, 1990).

Finally, traditional learning environments differ from OELEs in the responsibility level of the learner. In traditional learning environments, the learner has minimal responsibility; they attend class, complete activities and/or exercises in a variety of media; and are evaluated on their performance. The primary role of the instructor is of "sage" while that of the learner is "disciple:" one leads, the other follows. In OELEs, this role-play is very different, and often reversed. The learner directs the environment, while the instructor is there to support and guide when needed. The learner, in taking on a directive role, also takes on responsibility for what occurs in the environment, including the development of understanding.

These fundamental differences create a unique opportunity to change educational environments to highly interactive, engaging situations, for both the learner and instructor. However, the challenges associated with creating these environments is not insignificant. In the next section, we present issues for design of OELEs, along with their inherent assumptions.

Assumptions and Issues for Design of OELEs

Assumption One: Understanding is best achieved when situated in relevant contexts that support the learner in connecting personal beliefs and experiences with formal concepts

One assumption of open-ended learning is that personal beliefs, experiences, and conceptual schemata support current, as well as provide the foundation for new, understanding (Hannafin, 1992). Background knowledge and experience form the conceptual referent within which new encounters are organized and assimilated (Piaget, 1976). Background context influences the choices learners make in the environment, the extent to which they persevere, and the types of goals they set. Accordingly, learner use of prior experiences as a referent for understanding is foundational to the design and development of OELEs.

Problem-based contexts are established in OELEs to influence how learners make decisions and access prior, related experiences. Problem-based contexts often provide orienting scenarios to guide learners in exploring the complexities of a topic. Such scenarios often focus on everyday problems (e.g., environmental pollution or contamination of drinking water) that can be readily identified by learners (Tobin & Dawson, 1992). In this way, the environment establishes a context for identifying unmet needs, accessing prior experiences, and generating plausible strategies and solutions.

Design Issues OELEs require learners to link everyday experiences with formal experiences (Hawkins & Pea, 1987). Without problem contexts designed to help learners access related prior experiences (e.g., provide science problems involving roller coasters that help learners use prior experiences with roller coasters) or external structures to prompt the connection of these experiences, learners will likely fail to bridge the gap between formal and experiential.

At times, however, learner prior experiences are not directly accessible, or often conflict, with formal concepts under study. Research in science misconceptions has indicated that individuals develop informal theories about scientific phenomena, which may help or hinder their subsequent learning (Driver & Scanlon, 1988). This is common in science and mathematics learning, for instance, where concepts are often abstract or when they are not easily represented in the learner's everyday experience. Newtonian motion, for instance, is based upon assumptions that take place in a gravity-free world. Since most learners do not experience gravity-free environments, it is difficult for them to connect prior experience to the formal. This provides a limited basis for understanding that, as a consequence, is often superficial, inert, and riddled with misconceptions (Carey, 1986). Assisting the learner in bridging the gap between everyday experiences and formal learning experiences is critical in the design of OELEs.

Research examining the development of cognitive strategies while using OELEs also indicates misapplication of everyday experience (Hill & Hannafin, in press; Hill, 1997). In these studies, learners were engaged in the task of retrieving information from the World Wide Web (WWW), one example of a technology-based OELE. In several instances, learners relied on their prior experience in retrieving information in a traditional electronic library catalog to inform their decisions. The use of this model was not sufficient to guide the learner as they searched for information on the WWW. The model generated was "...messy, sloppy [and] incomplete" (Norman, 1983). Assisting the learner in the creation of a mental model appropriate for the environment is a critical design component in OELEs.

In some situations learners may use misconceived prior experiences as the basis for interpreting the concepts under study in the OELE. OELEs such as microworlds are designed to allow learners to vary parameters, model or represent their understanding, and use simulations to test their validity (Rieber, 1992). In some instances, however, the system may be incapable of responding to learner misconceptions that are based in prior experiences if they cannot be tested operationally (Land & Hannafin, in press). Consequently, enduring conceptions result that are often difficult to alter. Assisting the learner as they develop skills associated with angling, that is viewing from multiple perspectives, is another critical design issue associated with OELEs (Duchastel, 1990).

Assumption Two: Provision of resources and tools help learners connect and manipulate understanding

OELEs increase learner access to both sources and perspectives related to the content under study. Tools for constructing and manipulating understanding are used to promote learning that is more concrete and capable of being tested. Often, a range of resources are provided that serve as repositories of information (e.g., CD-ROMs, encyclopedias). However, environments can also be designed to facilitate the *construction* of resources by learners. For instance, students can learn about fractions by designing and constructing educational software for teaching younger children about fractions (Harel & Papert, 1991). Similarly, tools such as *Intermedia* utilize a networked multimedia system where learners construct a "web" of concepts, and share them communally with other students. The use of resources, or opportunities to construct resources, provides a rich environment for extending understanding.

Tools, such as spreadsheets or word processors, provide opportunities for user-centered activity. In learning environments, tools help learners to manipulate features and processes. Some tools, such as those found in simulations and microworlds, allow learners to manipulate concepts by varying parameters and/or physical models (e.g., vary force and direction of an object in space, [Rieber, 1992]). Computerized tools can be used to select text for electronic notebooks, create hyperlinks between sources of information, or perform calculations (Hannafin, 1992). Tools allow learners to test complex theoretical concepts in concrete ways (Hannafin et al., 1994).

Design Issues Use of tools and resources in OELEs is a learner-directed activity. In this context, tools and resources provide an *opportunity* for use, but do not inherently enhance cognitive activity or skills. Perkins (1993) refers to the "fingertip effect" as a misconceived belief that automatic provision of tools or resources spontaneously prompts their use in the ways in which they were intended. Previous research has indicated, for instance, that learners often do not use the tools and resources provided by the system in ways that promote understanding (Hill & Hannafin, in press; Land & Hannafin, in press)., The way in which tools and resources are integrated into the environment influences the manner in which they will be used. The "seamless" integration of tools and resources needs to be a goal in the design of OELEs.

Interface design and feedback mechanisms offer useful structures for tool and resources use in technology-based OELEs. Interface techniques such as the use of metaphors (see, for example, Tobin & Dawson, 1992), prompts for where and how to find information, and required sequences for using and interpreting feedback (Lewis, Stern, & Linn, 1993) have been used as methods to facilitate intentional use of resources and tools. Regardless of the apparent power and affordances of tools and resources, it is unlikely learners will use them "mindfully" without thoughtful facilitation and well-designed interfaces (cf., Salomon, 1986).

In addition to encouraging the use of multiple tools and resources, OELEs should also be flexible in the ways in which the information retrieved and/or generated from these resources and tools is presented. Multiple views of the same information for learning complex material is one of the main tenets of cognitive flexibility theory (see, for example, Spiro et al., 1991). In order to support the learner in the creating *individual* understanding, OELEs need to allow the learner to manipulate and view the information in ways that best match their needs. Designing this flexibility into the environment will help support the learner in linking information in meaningful ways (Borsook & Higginbotham-Wheat, 1992).

Assumption Three: Learners must take more responsibility for monitoring, and reflecting upon, the learning process

To be effective during open-ended learning, learners must also monitor their thoughts and actions. Learners interact based upon metacognitive awareness of their understanding and the perceived need to validate or challenge their understanding (Perkins, 1993). This includes decisions to pursue additional practice, search for definitions or information, test a hypothesis, create a "what if" scenario, or take notes. Learners must be able to locate, select, organize, integrate, and use relevant information if they are to generate products and/or understanding. Similarly, learners must evaluate the adequacy of their approaches during open-ended learning (Belmont, 1989). This is especially important given the numerous learner control studies which suggest learners often fail to both invoke self-regulation strategies and to initiate and direct their own efforts (Steinberg, 1989; Zimmerman, 1989).

Design Issues Available tools and resources may fail to promote understanding if the OELE does not facilitate the needed cognitive or conceptual processes. Learners searching for information on the WWW demonstrated how access to a virtually limitless amount of information and resources is not sufficient in the pursuit of understanding (Hill, 1997; Hill & Hannafin, in press). Despite ready access at their "fingertips" (Perkins, 1993), the majority of the learners were unable to manipulate and use system features to further their own understanding.

Much of the lack of manipulation was attributed to "doing and not thinking." What the studies revealed was a lot of physical engagement (i.e., pointing and clicking) with the system by the learners rather than reflection before action. While "doing," or enactive mentality, is important, this alone is not sufficient for building understanding(Kay, 1990). Iconic mentality (i.e., recognition, comparison, and configuration) as well as symbolic mentality which enables sign interpretation and connections to familiar environments in making sense of the information, are also critical for developing strategies and processes in OELEs. In these Web-based studies (Hill, 1997; Hill & Hannafin, in press), the learners' lack of "sense-making" contributed to under-developed levels of understanding (Dervin & Nilan, 1986). This lack of understanding spanned both the information that was retrieved as well as the system itself. Guidance and assistance in developing monitoring and reflection techniques must be an inherent part of the design of OELEs if the learner is to develop the strategies and processes necessary for building understanding.

Recent design efforts have emphasized activities that induce and facilitate high-level cognitive processes, such as hypothesis generation, scientific reasoning, or metacognitive analysis. For instance, the *CSILE* environment is designed to facilitate metacognitive thinking through the use of prompts to generate questions, hypotheses, or theories (Scardamalia et al., 1989). Other environments facilitate scientific inquiry or critical thinking skills by embedding activities that induce learner hypotheses and observations prior to manipulating and collecting data (Lewis et al., 1993). Pedagogical approaches, as well as technological interventions, must embed structures for requiring the use of higher-order thinking, reflection, and evaluation.

Conceptual Framework for the Design of OELEs

In an effort to begin offering solutions to the challenges associated with designing OELEs, a conceptual framework has been developed (see Figure 1). The framework has represents a starting point for integrating problems and issues with approaches to designing OELEs; evaluation studies and/or empirical investigation have not yet been conducted.

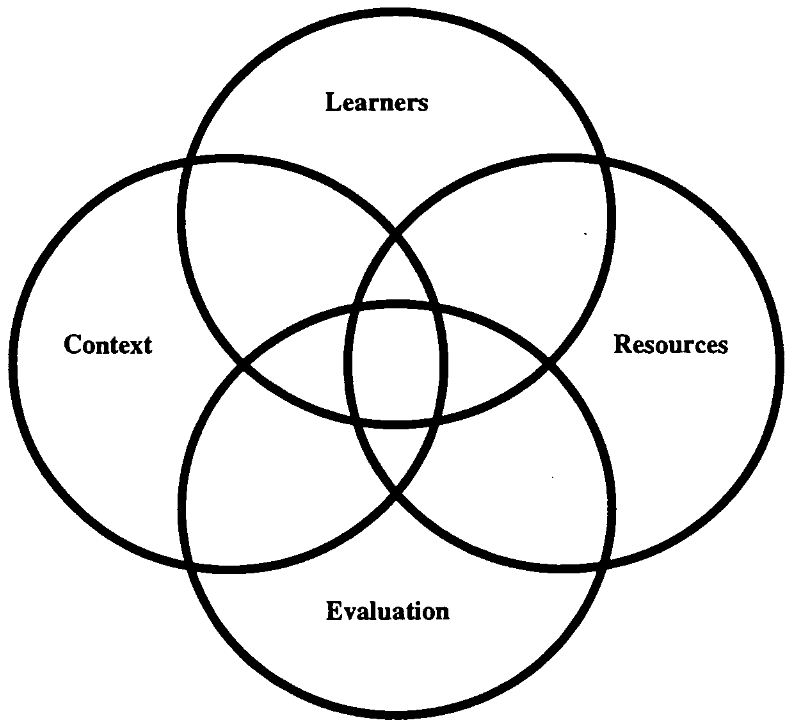

Figure 1. OELEs: Framework for Design

The three connecting circles represent three major components associated with OELEs: context, resources, and learners. Each of these is closely associated with the three assumptions presented earlier in the text. A fourth area, evaluation, has been added to the framework. As in all learning environments, evaluation is a critical component to ensure that goals are being reached. In OELEs, evaluation is not only a self-reflection technique for learners; it is critical on the part of the instructor to ensure that the needs of the learners are being met.

In designing OELEs, creating a context conducive to supporting individual needs is critical for supporting the development of understanding. This context needs to problem-centered, yet activity-based. The activities should also assist the learner in the development of an appropriate mental model, as well as encourage the use of multiple perspectives in developing understanding. By taking an additional step, grounding the environment in a problem-centered context defined by the learner, the task of bridging everyday experiences to formal learning situations will be even easier.

The provision of multiple resources and tools is another critical component in the design of OELEs. Using techniques of seamless integration, as well as following guidelines for well-designed interfaces, will enhance the use of these resources and tools. Flexibility should also be an integral part of the design of OELEs. Encouraging the learner to use the tools in a variety of ways, as well as advocating individual selection of resources which best match their needs, should also be a part of the design and development of these environments.

The learner is *the* focus of OELEs. As such, their role in OELEs is a critical component in the design of these environments. Developing strategies and processes which facilitate growth in understanding is a primary goal of OELEs. To enable learners to reach this goal, monitoring and reflection strategies need to be facilitated and encouraged. By facilitating the processes associated with evaluation and contemplation, OELEs can assist the learner in the use of higher-order thinking skills. This, in turn, will enable growth in understanding.

Conclusions and Implications

The design of OELEs is challenging; in fact, it can be an exceedingly complex undertaking. New responsibilities are created for both the instructor and learner engaged in these environments. The instructor can no longer play the role of "sage on the stage," but rather must move into the realm of "guide on the side." Concurrently, the learner must be prepared to take responsibility for developing understanding and learning. "Compliant thinking" is the antithesis of what occurs in OELEs (McCaslin & Good, 1992). OELEs are grounded in a familiar context; replete with resources, both human and non-human; and rich with activities and interactions amongst the participants. "Energetic thinking" is not only essential, but required if OELEs are to reach their true potential in assisting the learner in evolved understanding.

Resolving issues inherent to the design of overall context, resources and tools, and facilitation and feedback appear fundamental to advancing our understanding of how to design and develop OELEs. With a more inclusive understanding of how to operationalize underlying theoretical assumptions of OELEs, new directions for teaching and learning become not only inviting, but feasible.

References

Belmont, J. (1989). Cognitive strategies and strategic learning. *American Psychologist, 44* (2), 142-148.

Borsook, T. K., & Higginbotham-Wheat, N. (1992). *A psychology of hypermedia: A conceptual framework for R&D*. (ERIC Document Reproduction Service No. ED 345 697).

Carey, S. (1986). Cognitive science and science education. *American Psychologist, 41*(10), 1123-1130.

Dervin, B., & Nilan, M. (1986). Information needs and uses. In M. E. Williams (Ed.), Annual review of information science and technology, 21, 3-33.

Driver, & Scanlon, (1988). Conceptual change in science. Journal of Computer-Assisted Learning (5), 25-36.

Duchastel, P. C. (1990). Examining cognitive processing in hypermedia usage. Hypermedia, 2(3), 212-233.

Hannafin, M. J. (1992). Emerging technologies, ISD, and learning environments: Critical perspectives. *Educational Technology Research and Development, 40* (1), 49-63.

Hannafin, M. J., Hall, C., Land, S. M., & Hill, J. R. (1994). Learning in open-ended environments: Assumptions, methods, and implications. *Educational Technology, 34* (8), 48-55.

Harel, I., & Papert, S. (1991). Software design as a learning environment. In I. Harel & S. Papert (Eds.), *Constructionism* (pp. 41-84). Norwood, NJ: Ablex.

Hawkins, J. & Pea, R. (1987). Tools for bridging the cultures of everyday and scientific thinking. *Journal of Research in Science Teaching, 24* (4), 291-307.

Hill, J. R., & Hannafin, M. J. (in press). Cognitive strategies and learning from the World Wide Web. *Educational Technology Research & Development.*

Hill, J. R. (1997). *Cognitive strategies and the use of an open-ended information system*. Manuscript in progress.

Kay, A. (1990). User interface: A personal view. In B. Laurel (Ed.), *The art of human-computer interface design* (pp. 191-207). New York: Addison-Wesley.

Land, S. M., & Hannafin, M. J. (in press). *Educational Technology Research & Development.*

Lewis, E., Stern, J., & Linn, M. (1993). The effect of computer simulations on introductory thermodynamics understanding. *Educational Technology, 33* (1), 45-58.

McCaslin, M., & Good, T. (1992). Compliant cognition: The misalliance of management and instructional goals in current school reform. *Educational Researcher, 21*(3), 4-17.

Norman, D. (1983). Some observations on mental models. In D. Gentner & A. L. Stevens (Eds.), *Mental models* (pp. 7-14). Hillsdale, NJ: Lawrence Erlbaum.

Papert, S. (1993). *The children's machine: Rethinking school in the age of the computer.* New York: Basics Books, Inc.

Piaget, J. (1976). *The grasp of consciousness.* Cambridge, MA: Harvard University Press.

Perkins, D. N. (1993). Person-plus: A distributed view of thinking and learning. In G. Salomon's (Ed.), *Distributed Intelligence* (pp. 88-109). New York: Cambridge.

Rieber, L. P. (1992). Computer-based microworlds: A bridge between constructivism and direct instruction. *Educational Technology Research & Development, 40* (1), 93-106.

Roth, W., & Roychoudhury, A. (1993). The development of science process skills in authentic contexts. *Journal of Research in Science Teaching, 30* (2), 127-152.

Salomon, G., (1986). Information technologies: What you see is not (always) what you get. *Educational Psychologist, 20*, 207-216.

Scardamalia, M., Bereiter, C., McLean, R., Swallow, J., & Woodruff, E. (1989). Computer-supported intentional learning environments. *Journal of Educational Computing Research, 5* (1), 51-68.

Spiro, R., Feltovich, P., Jacobson, M., & Coulson, R. (1991). Cognitive flexibility, constructivism, and hypertext: Random access instruction for advanced knowledge acquisition in ill-structured domains. *Educational Technology, 31* (5), 24-33.

Steinberg, E. (1989). Cognition and learner control: A literature review, 1977-1988. *Journal of Computer-Based Instruction, 16*, 117-121.

Tobin, K. & Dawson, G. (1992). Constraints to curriculum reform: Teachers and the myths of schooling. *Educational Technology Research and Development, 40*(1), 81-92.

Zimmerman, B. (1989). A social cognitive view of self-regulated academic learning. *Journal of Educational Psychology, 81* (3), 329-339.

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